

# PATENT SPECIFICATION

DRAWINGS ATTACHED

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## COMPLETE SPECIFICATION

### Internal Combustion Engine of the V-type

We, AKTIEBOLAGET GOTAVERKEN, a Swedish Body Corporate of Stjärngatan 9, Gothenburg, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to V-type internal combustion engines and particularly to big ship diesel engines, in which a lobed cam disc co-operating with rollers on the ends of the piston rods transfers the power developed in the cylinders of the engine to the output shaft.

In a cargo ship of conventional design the number of revolutions of the propeller shaft is low. In order to avoid speed reduction gears, which are expensive and reduce the efficiency of the plant, the propulsion engine of the diesel type is usually designed to operate at the same speed as the propeller.

In order to achieve the high output today demanded of big ship internal combustion engines it has been necessary to increase the dimensions which has the consequence that the engine-room will demand a considerable space both in the longitudinal direction as well as in the vertical direction and besides disadvantages are caused by the heavy weight and the large volume of the units of each engine.

In internal combustion engines having a cam disc instead of cranks a reduction in the rotary speed of the output shaft is achieved without any gear, the reduction ratio being proportional to the number of cams of the cam disc. For instance if the cam disc has three cams the piston in the cylinder will move three times up and down during each revolution of the output shaft whereby either the capacity of the engine

can be substantially reduced compared with a conventional internal combustion engine or the output of an engine having the same capacity will be substantially increased.

However there are also problems in engines of this type. The roller is positively guided by the cam in one direction only, and it has therefore been proposed to arrange two cylinders in V-form and to connect the piston rods of these two cylinders by means of a yoke pivotally mounted on a stationary shaft. The two pertaining rollers will then be guided by the swinging movements of the ends of the yoke. As the reciprocatory movements of the two rollers are phased displaced in relation to each other and as each roller must always be kept in contact with the cam disc the V-angle must be chosen with respect to the curvature of the cam.

In internal combustion engines having a piston rod reciprocating without any swinging movement means have to be provided for taking up the thrust directed laterally of the rod.

The present invention is an improvement of means previously known in V-type internal combustion engines in which each of the two piston rods of each pair of cylinder units in V-form is provided at its free end with a roller cooperating with cams on a cam disc on the engine output shaft and the movement of the two piston rods is synchronized by means of a pivotal yoke on a stationary shaft, each piston rod being firmly connected to a piston reciprocable in a respective cylinder, and is characterized in that each piston rod is provided with a laterally directed cross-head running in guides in the casing of the engine in order to take up laterally directed forces on the piston rod, and in that each end of the yoke is forked with the facing surfaces on the

shanks of the fork constituting roller surfaces for co-operating cylindrical surfaces on an associated one of the cross-heads in order to reduce wear of the co-operating surfaces.

The invention will be described with reference to the accompanying drawings, in which Fig. 1 is a cross-section through an internal combustion engine having a cam disc, Fig. 2 is an elevation seen in the direction of the arrows II-II of Fig. 1, Fig. 3 is a schematic view in the direction of the arrows III-III of Fig. 2 showing a swingable yoke connecting the piston rods of two engine cylinders in V-form and Fig. 4 is a view corresponding to Fig. 3 with the yoke in another position.

The internal combustion engine is of V-type having a number of cylinders arranged pair by pair the angle between the rows of cylinders being dependent on the number of cams on the output shaft. In the two-stroke engine shown an output shaft 2 is rotatably mounted in a bearing frame 1 and provided with a cam disc 3 having three equally spaced cams 4 for each pair of cylinder units 6 and 7 mounted on a casing 5, the cylinders being arranged at an angle of 60°. Each cylinder 6 and 7 has a reciprocating piston 8 and is associated with accessories such as an injection device for fuel, valves, exhaust ports, a cam shaft, a valve mechanism and a starting device. A respective piston rod 9 is firmly fastened to each piston 8 which piston rod at its free end is forked and provided with a roller 10 rotatable on a shaft 11 extending through the shanks of the fork. In order to effectively avoid combustion products entering the casing 5 the piston rod 9 is sealed with packings 12 in a known manner. The pistons 8 and the piston rods 9 with the rollers 10 reciprocate in the cylinders 6 and 7, the movement upwards in the cylinder being performed by the rotation of the cam disc 3 whereas the downwards directed movement is performed by the combustion thrust in the cylinder. In order to avoid shocks at the dead centres each roller 10 has to accurately follow the cam curve 4 and therefore sudden changes of the cam curvature must be avoided. Thus the cam curve preferably is so formed that the radius of curvature at the radially outermost part of the cam is about 50% greater than the radius of the rollers 10 and that the acceleration for the centre of the rollers is continuous between the dead centres.

The power developed in each of the cylinders 6 and 7 is transferred by the piston 8 and the piston rod 9 to the roller 10 and is divided into one component in the direction of the axis of the cylinder and one component directed at right angles to said axis.

In accordance with the invention said last-

named component is taken up by guides 13 on the inner wall of the casing 5 in which guides a cross-head 14 on the shaft 11 of the roller 10 is guided.

In the axial direction of the power output shaft 2 a pin 15 is inserted in the casing 5 on which pin a yoke 16 connecting the two piston rods 9 is pivotally mounted. The object of the yoke 16 is to synchronize the movements of the two piston rods 9 and also to transfer the movement from one piston rod to the other. As the pivot centre of the yoke 16 is stationary and the movement of the piston rods 9 is rectilinear the connection between the yoke 16 and the piston rods 9 must be loose and for that reason the ends of the yoke 16 are each formed as a fork 17 having guide surfaces 18 facing each other which surfaces 18 co-operate with cylindrical surfaces 19 on the cross-head 14. The cross-head 14 has plane side surfaces 20 running in a groove in the guide 13. Sliding action between the surfaces 19 and the guide surfaces 18 of the fork 17 should be avoided especially when the contact point is loaded. Therefore the radius of the surfaces 19 and the distance from the pivot point of the yoke 16 to the contact point on the guide surfaces 18 are so inter-related that the contact between the cross-head 14 and the yoke 16 substantially takes place under rolling action so that wear is reduced and the lubrication problem will be simplified and a high pressure on the surfaces may be permitted.

The engine as shown is also intended for reversed rotation and therefore the cams 4 are symmetrically curved, but in engines intended for rotation in one direction only said cams may be unsymmetrically curved in order to produce the working conditions wanted. The cylinders and the driving means for the regulating mechanisms are, broadly speaking, constructed in the same manner as in a conventional internal combustion engine. Thus, for instance, the transmissions for the cam shafts, the valves and the injection devices can be driven from the output shaft 2 by means of a chain or a cog-wheel gearing having the gear ratio adjusted to the number of cams on the cam disc 3. The number of pairs of cylinders may be arbitrarily chosen up to about 15 and the output shaft 2 of course must be dimensioned considering the output of the engine.

The internal combustion engine according to the invention will work with substantially less vibrations than a conventional engine having the same number of cylinders and also with less pulsation of the moment available at the output shaft.

#### WHAT WE CLAIM IS:—

1. An internal combustion engine of V-type, in which each of the two piston rods of each pair of cylinder units in V-form is

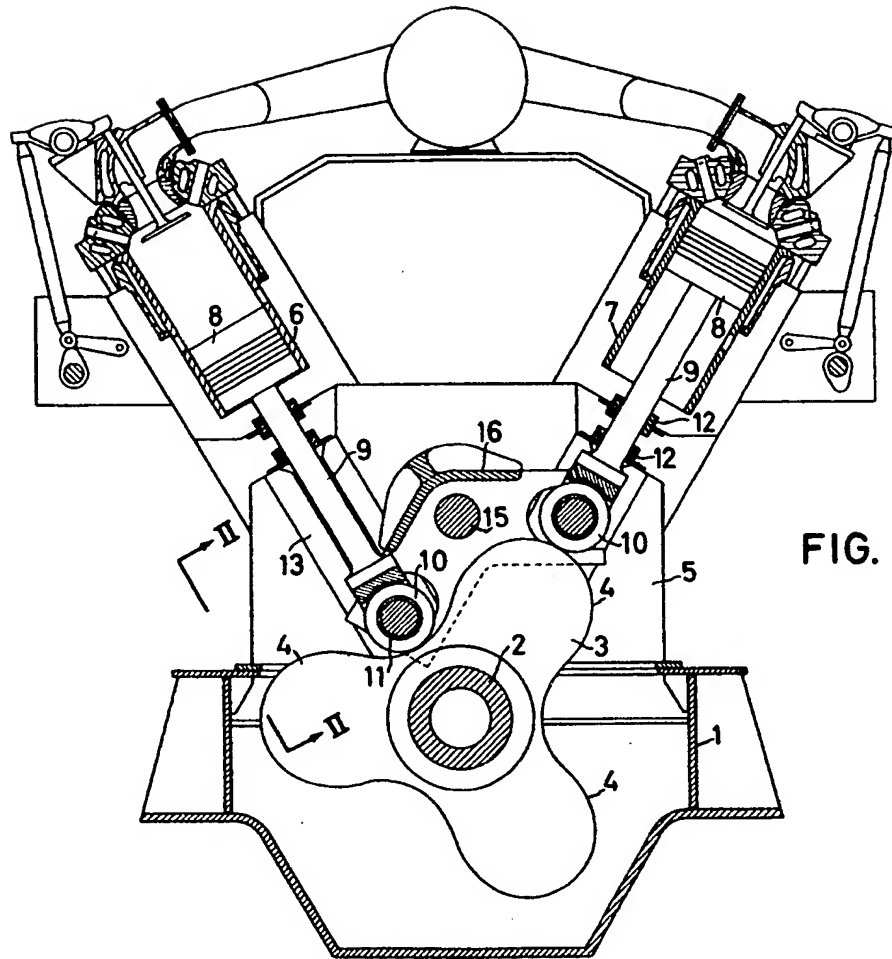
provided at its free end with a roller co-  
operating with cams on a cam disc on the  
engine output shaft and the movement of  
the two piston rods is synchronized by  
5 means of a pivotable yoke on a stationary  
shaft, each piston rod being firmly con-  
nected to a piston reciprocable in a respec-  
tive cylinder, characterized in that each pis-  
ton rod is provided with a laterally directed  
10 cross-head running in guides in the casing of  
the engine in order to take up laterally  
directed forces on the piston rod, and in  
that each end of the yoke is forked with  
the facing surfaces on the shanks of the fork  
15 constituting rolling surfaces for co-operat-  
ing cylindrical surfaces provided on an  
associated one of the cross-heads in order to  
reduce wear of the co-operating surfaces.

2. An internal combustion engine as  
claimed in claim 1, characterized in that the 20  
cross-heads are provided on the shafts on  
which the rollers are mounted.

3. An internal combustion engine as  
claimed in claim 1, characterized in that the  
radius of curvature of the radially outer- 25  
most part of the cams is about 50% greater  
than the radius of the rollers.

4. An internal combustion engine sub-  
stantially as hereinbefore described with  
reference to and as illustrated in the accom- 30  
panying drawings.

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2 SHEETS

COMPLETE SPECIFICATION

*This drawing is a reproduction of  
the Original on a reduced scale.*

SHEET 2

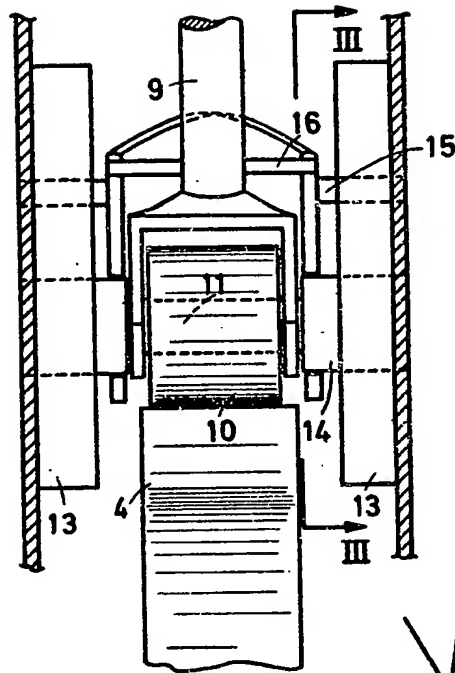


FIG. 2

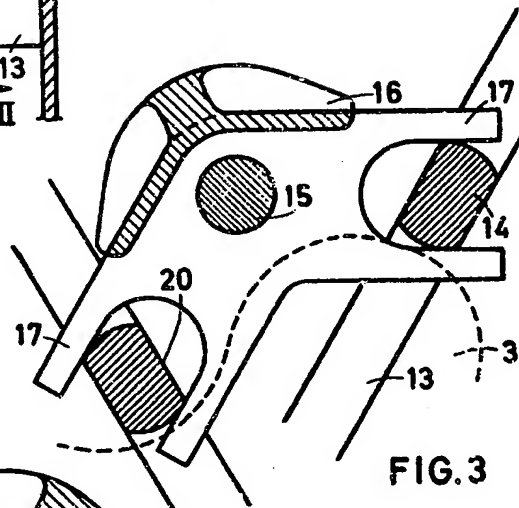


FIG. 3

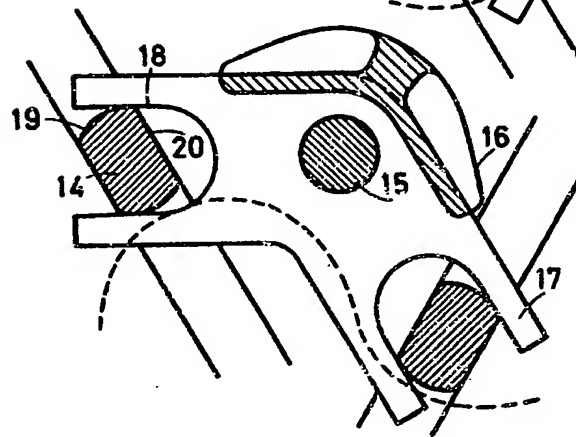


FIG. 4